WHITE PAPER NO. 7 – LOWER FOX RIVER DREDGED SEDIMENT PROCESS WASTEWATER QUALITY AND QUANTITY: ABILITY TO ACHIEVE COMPLIANCE WITH WATER QUALITY STANDARDS AND ASSOCIATED WPDES PERMIT LIMITS

Response to Comments Received on the

PROPOSED REMEDIAL ACTION PLAN

FOR THE LOWER FOX RIVER AND GREEN BAY

January 2002

This Document has been Prepared by

Wisconsin Department of Natural Resources

December 2002

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ABSTRACT

On October 5, 2001, the public comment period was opened for the *Proposed Remedial Action Plan, Lower Fox River and Green Bay* (Proposed Plan) (WDNR and EPA, 2001) developed by the Wisconsin Department of Natural Resources (WDNR) and United States Environmental Protection Agency (EPA) Region 5. Many comments were received during the comment period, which in part challenged the viability of the Proposed Plan based on discharge water quality and quantity concerns. In particular, the comment authors claimed that the dredging recommended in the Proposed Plan was not viable because the quality and quantity of wastewater generated in the dredging process could not comply with Water Quality Standards (WQS) and associated WPDES permit limits, even using the most advanced wastewater treatment process. The wastewater quantity and quality limitations would, therefore, restrict the allowable wastewater discharge rate, thereby decreasing the allowable dredging rate and increasing the dredge schedule from the 7 years estimated in the Proposed Plan to as much as 37 to 60 years. Based on these assumptions, the comment authors concluded that in-place sediment capping was the only viable alternative for remediation of the Lower Fox River sediment.

In response to these comments, the WDNR analyzed the assumptions used to support the comment conclusions, and performed an evaluation to determine if the expected dredge process wastewater characteristics and volumes would restrict or limit the viability of the Proposed Plan as claimed in the comments. This White Paper provides a summary of WDNR's analyses and responses to these comments. This analysis concludes that dredge process wastewater quantity and/or quality do not restrict the viability of dredging as recommended in the Proposed Plan, and do not justify capping.

COMMENT SUMMARY

Although the comments were quite voluminous, they have been condensed to the following key issues and assumptions summarized below. The comments discussed in this White Paper and the following comment summary are based on a report received from a panel of scientists and engineers hired by Appleton Papers, Inc., referred to as the API Panel. The API Panel report is titled *Ecosystem-Based Rehabilitation Plan – An Integrated Plan for Habitat Enhancement and Expedited Exposure Reduction in the Lower Fox River and Green Bay* (Panel Report) (The Johnson Company, 2002). Many of these comments were also provided by other companies, organizations, or individuals, but they were all based on or similar to the Panel Report, and are therefore addressed in this White Paper.

1) The comment authors claimed that remediation process wastewater must be treated to meet the most restrictive federal and state WQS and requirements prior to discharge to the Lower Fox River. Wisconsin Pollution Discharge Elimination System (WPDES) rules preclude the issuance of a discharge permit if a discharge will not attain WQS. The WQS for Bioaccumulative Chemicals of Concern (BCCs) for new or increased discharges must be the most stringent of those parameters contained in Wisconsin Administrative Code (WAC) Chapter NR 105.

2) The comment authors claimed that no assimilative capacity is available for biological oxygen demand (BOD) since that capacity is already fully allocated.

3) The comment authors claimed that wastewater generated in the remediation process at their estimated rate of 4.3 million gallons per day (mgd) in Operable Unit 1 (OU 1), and 23.7 mgd in OUs 3 and 4, even using the most advanced treatment technology, can not achieve the applicable WQS and associated WPDES permit limits.

4) The comment authors claimed that the expected wastewater discharge rate and quality would exceed the assimilative capacity of the Lower Fox River. Assuming the very best treatment results reported, the assimilative capacity of the River restricts the maximum discharge rate to 4.25 mgd, based on assumed treated effluent concentrations of dieldrin, endrin, cadmium, and mercury.

5) The comment authors claim that the wastewater generation rate should be 4,100 gallons per cubic yard (gal/cy) of dredged sediment, which is five times the rate contained in the Proposed Plan. This assumption increases the volume of dredge process wastewater needing treatment from the 0.7 to 5.0 mgd estimated in the Proposed Plan to the API Panel estimate of 4.3 to 23.7 mgd.

6) The comment authors claim that a maximum wastewater discharge rate of 4.25 mgd and a wastewater generation rate of 4,100 gal/cy of dredged sediment results in a maximum dredge rate of 1,050 cubic yards per day (cy/day), which extends the estimated dredge schedule from the Proposed Plan estimate of 7 years to as much as 37 to 60 years.

ANALYSIS OF COMMENTS AND ASSOCIATED ASSUMPTIONS

Ability of Dredge Process Wastewater to Comply with WQS and Associated Permit Limitations

General Response

This comment essentially said that remediation process wastewater must meet applicable state and federal requirements, and that WPDES rules preclude the issuance of a discharge permit if the discharge will not achieve WQS, and that WQS for BCCs for new or increased discharges must be the most stringent standard contained in WAC Chapter NR 105. The WDNR agrees that any wastewater discharge must meet state and federal requirements but does not agree that those requirements restrict the wastewater discharge

to the extent concluded in the comment. This comment contains two major issues requiring a response.

The first issue is that of whether the remediation process wastewater discharge should be considered a new or increased discharge. Although the discharge of remediation process wastewater could be considered a new or increased discharge, realistically the discharge is not new and is not a net increase, since the sediment is already in the Lower Fox River and contributing contaminants to the system. In fact, another comment from the same author points out the placement of the Lower Fox River and inner Green Bay on the Clean Water Act's (CWA's) Section 303(d) list, as impaired waters not currently meeting WQS, is in part due to the sediment contribution of polychlorinated biphenyls (PCBs), 4,4'-Dichlorodiphenyl trichloroethane (DDT), dieldrin, arsenic, and mercury. Although there may be a short-term increase of contaminants in the water column from the dredging process, the net long-term reduction in the overall presence and contribution of contaminants from the sediment outweighs the short-term increase. It is, therefore, most appropriate to view the remedial dredging project as an action to reduce or eliminate an existing discharge of contaminants. Although this view does not actually change how limits are calculated under Wisconsin regulations, it is important in maintaining perspective of the project goal to remove contaminants, and their associated impacts, which are already present in the River system.

The second issue is that of whether Wisconsin's regulations limit the WDNR's ability to issue a WPDES permit in this case, and if the most restrictive permit limits would apply. Wisconsin rules do not require the application of the most restrictive WQS as the permit limit in cases where the receiving water background concentration exceeds the WQS. Chapter NR 106 is the WAC containing the requirements for the calculation of water quality based effluent limits for toxic and organoleptic substances discharged to surface waters. NR 106.06(6) WAC establishes the conditions under which alternative limits based on background concentrations are determined and provides the flexibility to apply a Net Environmental Benefit concept when addressing situations such as this, where the contaminants are already in the system. This section of the code essentially says that whenever background concentrations for toxic or organoleptic substances in the receiving water exceed the applicable WQS, and at least 10 percent of the source water is from the receiving stream, the effluent limit for that substance may be set at the background concentration, or an alternate limit or requirement may be determined. An alternate limit or requirement may be determined if the discharger's relative contribution of the mass of the contaminant to the receiving water body is negligible in the best professional judgment of the WDNR, and if the WDNR judges that Best Demonstrated Treatment Technology Reasonably Achievable (BDTTRA) is provided. The alternate limit or other requirement may include one or more of the following permit conditions, a numerical limit (which can be greater or lower than the WQS), a monitoring requirement, or a cost-effective pollutant minimization program (which could include a specific treatment technology or performance standard).

Since the Lower Fox River is actually 100 percent (far greater than 10 percent) of the source water, and background concentrations exceed the WQS for PCBs and mercury, which are toxic substances, subject to the provisions of NR 106 WAC, alternative limits

are appropriate for these substances. DDT and dieldrin were not detected, and arsenic was either not detected or not present at levels requiring permit limits in the Deposit N and Sediment Management Unit (SMU) 56/57 demonstration project effluents. Application of the same or similar technology utilized in the demonstration projects is considered by the WDNR to be BDTTRA, and the PCB and mercury mass contained in the wastewater discharge are considered negligible. Therefore, the application of alternative limits or requirements other than background concentrations is reasonable, appropriate, and fully in conformance with existing rules.

Specific Response

Determination of Probable WPDES Permit Limits:

The comment conclusions that remedial dredging is not a viable option are predicated on the assumption that the allowable wastewater discharge rate is limited by the Lower Fox River's assimilative capacity, applicable WQS, and associated WPDES permit limits. In response, the WDNR's Bureau of Watershed Management completed two evaluations of the need for WPDES permit limits, copies of which are attached to this paper as Attachments 1 and 2. The subject line of Attachment 1 is "Discharge Limitations for the Proposed Discharges for the Fox River PCB Remediation Projects," (WDNR, 2002a) and addresses the need for Water Quality Based Effluent Limits (WQBELs) for toxic compounds. The subject line of Attachment 2 is "Unused Lower Fox River Assimilative Capacity in Clusters I, II, and III," (WDNR, 2002b) and addresses the question of Lower Fox River BOD assimilative capacity availability for the proposed sediment remediation plan. The WDNR evaluated effluent quality data and bench-scale testing Priority Pollutant (PP) data from the Lower Fox River Deposit N and SMU 56/57 demonstration projects, along with the estimated discharge rates contained in the Proposed Plan and those estimates provided in the comments. As part of the demonstration projects, four separate sets of treated effluent samples were analyzed for the PP. Two were from bench-scale tests using Deposit N and SMU 56/57 sediment as part of the pre-design phase of the projects. The other two analyses were from effluent collected during normal operation of the actual Deposit N and SMU 56/57 demonstration projects in 1998 and 1999. Since the same or equivalent wastewater treatment technology applied in the demonstration projects is proposed for full-scale remediation, it is assumed that full-scale effluent quality will be similar to and representative of the demonstration project effluent quality. A summary of that effluent data is provided in Table 1, on page 8 of this report.

WQBELs for Toxic Compounds: PCBs and Mercury

Considering the expected full-scale wastewater discharge volumes and quality, and Wisconsin Water Quality Standards and associated WQBEL calculation requirements, the WDNR determined (see Attachment 1) that PCBs, mercury and ammonia were the only three compounds of concern at this time. No other compounds were identified as needing limits because they were not found in the demonstration project effluents at levels of concern, in fact most compounds were below the level of detection (LOD).

This current permit limit evaluation is consistent with the two 1998 WPDES permit limit determinations for the Deposit N and SMU 56/57 demonstration projects. When carbon adsorption treatment was utilized, even without application of a zone of initial dilution

(ZID) calculation, the only toxic substances requiring limits were PCBs, mercury and dioxin. Only PCB limits were determined using an alternate limit approach. WPDES permit limits were not needed for any other toxic substance when calculated using Wisconsin regulations and standard protocol, even without a ZID or any other special consideration. Since permit limits were determined in 1998, significant additional effluent data from those projects was obtained and used as the basis for the WDNR's current evaluation of the need for permit limits. Consideration of the additional data confirms the appropriateness of the 1998 limits determination and results in a similar conclusion in this current evaluation, except for the elimination of the need for dioxin limits.

The comment authors provided an extensive analysis and interpretation of various federal and state regulations, which led to their conclusion that the quantity and quality of dredge process wastewater limited the viability of the Proposed Plan. They did not, however, account for the flexibility built in to the regulations, and did not use effluent data representative of the demonstration projects. This resulted in the overestimation of expected effluent concentrations for several toxic substances and an overestimation of the need for permit limits and their associated impacts on the viability of the Proposed Plan. When the appropriate representative effluent data is used in the evaluation of the need for WPDES permit limits for toxic substances using standard Wisconsin regulations and protocol, only PCBs and mercury were identified as needing limits, which can be addressed through the alternate limit process provided in NR 106.06(6).

The evaluation in Attachment 1 provides a description of the methodology the WDNR will use in the development of PCB and mercury WPDES limitations for the proposed sediment remediation project. The discussion points out that since PCBs and mercury are BCCs, they would normally be limited to levels equal to the lowest water quality criteria (WQC), which are well below the current level of detection. However, since the Lower Fox River background concentrations already exceed the WQC for PCBs and mercury, WAC NR 106.06(6)(c) and (d) allows for the application of alternate effluent limits or requirements, as provided in the actual code language below:

NR 106.06(6) (c) & (d)
NR 106.06(6)(c)

1. Whenever the representative background concentration for a toxic or organoleptic substance in the receiving water is determined to be greater than any applicable water quality standard or criteria for that substance and the source of more than 10% of the wastewater for any discharger is from the same receiving water, the effluent limitation for that substance shall, except as provided in subd. 2., equal the representative background toxicant concentration of that substance in the receiving water as determined by the department, or an alternate limitation or requirement may be determined according to par. (d).

2. The department may establish an effluent limitation more stringent than the representative background concentration when the existing treatment system has a demonstrated and cost-effective ability to achieve regular and consistent compliance with a limitation more stringent than the representative background concentration.

NR 106.06(6)(d)

(d) Where appropriate, for effluent limitations determined under pars. (b) and (c), the department may conduct an analysis for a toxic or organoleptic substance which accounts for all sources of the pollutant impacting a waterbody or stream segment. In the event the discharger's relative contribution to the mass of the toxic or organoleptic substance impacting the waterbody or stream segment is negligible in the best professional judgment of the department, and the concentration of the substance in the discharge exceeds the representative background concentration of the substance, the department shall establish an alternative effluent limitation for the discharger. In determining whether the discharger's relative contribution to the mass of the substance is negligible, consideration shall be given to the type of substance being limited, the uses of the receiving water potentially affected and other relevant factors. The alternative effluent limitation or other requirement shall represent in the judgment of the department, application of the best demonstrated treatment technology reasonably achievable. An alternative effluent limitation or other requirement may include one or more of the following permit conditions:

1. A numerical limitation for the substance;

2. A monitoring requirement for the substance; or

3. A cost-effective pollutant minimization program for the substance as defined in s. NR 106.04(5).

The WDNR's evaluation concluded that the conditions for application of an alternate limit or requirement were met, and has determined that it is appropriate to apply the provisions of NR 106.06(6)(c) or (d) to establish limits for this project.

Determination of Negligibility:

As noted, the background concentration in the Lower Fox River is greater than the water quality criterion for PCBs and mercury. Under this condition, the WDNR, in implementing this part of the rule, must first establish that the discharge is negligible, in the best professional judgment of the WDNR. The concentration and mass of PCBs and mercury expected in the effluent are only a small fraction of the PCBs and mercury already annually released from the sediment and transported in the water column, and an even smaller fraction than that contained in the sediment.

The *Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin* (RI) (RETEC, 2002a) estimates that from 275 to 620 pounds per year (lbs/yr) of PCBs, and an average of 220 lbs/yr of mercury (range of 22 to 661 lbs/yr) were transported in to Green Bay from the Lower Fox River during the last decade. The expected effluent PCB concentration is below the 0.3 micrograms per liter (µg/L) LOD, and mercury is below the 0.5 nanograms per liter (ng/L) LOD. Assuming the effluent PCB and mercury concentrations are actually at the LOD, and assuming the wastewater discharge rates estimated in the Proposed Plan (0.7 mgd in OU 1, and 5.1 mgd in OUs 3 and 4), the discharge of PCBs would be 4.8 lbs/year (0.8 to 1.7 percent) of the current annual total load), and the discharge of mercury would be 0.0082 lbs/yr (0.004 percent) of the current annual mercury total load. Assuming the actual effluent concentrations are realistically well below the LOD, the actual discharge mass of PCBs and mercury is likely much lower than this analysis shows.

The removal of sediment results in a very substantial net reduction of PCB and mercury mass in the Lower Fox River system, and does not introduce any new contaminants to the system. The Proposed Plan recommends the removal of 29,250 kilograms (kg) (64,600 pounds) of PCBs from the system, while less than 13.6 kg (30 pounds) or 0.04 percent would be returned in the effluent over the 7-year length of the project. Leaving the sediment in the River just one additional year results in the release of 10 times more PCBs to the River from the sediment than would occur in 7 years of effluent discharge from the full-scale project. Although no mass mercury calculations have been determined for the 7.3 million cubic yards (cy) of proposed sediment removal, there is clearly a similar net removal of mercury from the system. The WDNR has determined, therefore, that the discharge from this project is negligible in accordance with the provisions in NR 106.06(6)(d) WAC.

Further support of this determination of negligibility is provided by the demonstration projects which showed only a small fraction of the mass of PCBs and mercury removed in the sediment was returned in the effluent or released during the dredging process. Significant monitoring was performed and reported on the 1999 SMU 56/57 demonstration project by Montgomery Watson, the United States Geological Survey (USGS), and Blasland, Bouck & Lee (BBL). The data shows that while 1,441 pounds of PCBs, and 30.3 pounds of mercury were removed from the River in the dredged sediment, that only about 0.3 pound or about 0.02 percent of the PCB mass, and about 0.0076 pound or 0.025 percent of the mercury mass was returned to the River via the effluent. The USGS and BBL reports also estimated the release of PCBs to the River from the dredging process, which showed that about 32 to 48 pounds of PCBs or 2.5 to 3.3 percent of the mass of PCBs dredged was released during the dredge process. According to the USGS report, this release represents only about 9 percent of the 409 pounds of PCBs annually transported by the Lower Fox River in 1994–1995.

The year 2000 SMU 56/57 demonstration project also showed that of the 670 pounds of PCBs removed in the dredged sediment, less than 0.143 pound or 0.02 percent of the PCB mass was returned via the effluent. It should be noted that in both the 1999 and 2000 SMU 56/57 demonstration projects, only one effluent sample had a detectable concentration of PCBs, while all the other samples were below the 0.26 to 0.33 PCB analytical level of detection (LOD).

Application of BDTTRA:

As part of the alternate limit eligibility determination, the WDNR must determine that the BDTTRA is being applied. Based on the performance of the Lower Fox River Deposit N and SMU 56/57 demonstration project wastewater treatment technology, which included sand filtration and granular activated carbon (GAC) adsorption, and considering EPA treatment manuals referred to in Attachment 1, the WDNR has determined that this same or similar technology represents the application of BDTTRA for PCBs and mercury. Sand filtration and GAC is the technology utilized in the *Feasibility Study for the Lower Fox River and Green Bay, Wisconsin* (FS) (RETEC, 2002b) cost analyses of alternatives. Based on the wastewater treatment performance in these projects, the WDNR expects effluent quality from the full-scale projects to achieve PCB concentrations less than 0.1 to 0.5 µg/L, and mercury concentrations less than 0.2 to 0.5 ng/L. These expectations will

be factored into the determination of alternate limits as part of the actual permit limit determination process as implementation of the final Proposed Plan proceeds.

WQBELs for Toxic Compounds: Ammonia

Ammonia in the dredge process wastewater was also identified as a concern, due to its toxicity and dissolved oxygen demand. In fact, comments received after the official comment period ended indicated effluent ammonia was one of the most significant reasons dredging was not feasible.

The WDNR's Bureau of Watershed Management evaluated the need for ammonia effluent limits using the demonstration project effluent data, background receiving water data, and expected discharge flow rates. Although demonstration project effluent ammonia data shows some values as high as 49 milligrams per liter (mg/L), those instances of higher ammonia levels were associated with the startup period of Deposit N, and in the first 6 weeks of SMU 56/57 (1999) due to design and associated operational problems. After wastewater treatment system improvements were completed at SMU 56/57 in 1999, the average effluent ammonia concentration was 8 mg/L and the average at Deposit N was 6 mg/L. These values are representative of the typical effluent quality expected from the full-scale project. Under these conditions, effluent ammonia limitations are substantially greater than expected effluent quality; therefore, it is expected that ammonia limits will not be needed.

Although effluent limits were not actually calculated as part of this exercise, a weekly average summer ammonia limit of 12 mg/L for the De Pere Wastewater Treatment Facility was determined in 2001 using a design flow of 14.2 mgd, which is almost three times the Proposed Plan estimated discharge rate of 5 mgd.

Another factor which needs to be considered is that Wisconsin's ammonia standard is currently under review, and that current drafts indicate summer (warm water season) criteria may be increased, potentially making expected effluent ammonia concentrations even less of an issue. The need for effluent ammonia limits for a full-scale dredging operation will of course be reevaluated as the implementation process and associated permitting proceeds.

Although the WDNR has determined that under the expected full-scale dredging conditions ammonia limits will not be needed, there are a number of other factors which should be considered when evaluating the ammonia issue. First, as with PCBs and mercury, the effluent ammonia comes from the sediment, which is already in the system, so the discharge does not represent any new contribution to the system. Although there does not appear to be Lower Fox River sediment research that quantifies the flux of ammonia from the sediment into the water column, there is significant sediment pore water data which does document high levels of ammonia in the sediment. Given the dynamic hydrology of the Lower Fox River, and the solubility and volatility of ammonia, and the fact that PCBs and mercury are moving from the sediment into the water column, the sediment is also currently considered a source of ammonia to the water column. The WDNR believes that removal of much of the soft sediment will remove much of the existing reservoir of ammonia resulting in a net reduction of ammonia input to the

system. Therefore, even if a portion of the sediment ammonia is released back into the receiving stream via the wastewater discharge, the sediment source and associated ammonia release is removed, thereby eliminating, at least temporarily, substantial future releases.

Another consideration is that ammonia, unlike PCBs and mercury, is readily biodegradable. In the biodegradation process known as nitrification, ammonia is converted to nitrate, a non-toxic form of nitrogen. As part of this process, oxygen is consumed, thus exerting a BOD. As pointed out in the following discussion on Wasteload Allocation (WLA), there is a substantial unused assimilative capacity, which far exceeds the BOD demand of the nitrification process. But more importantly, the Lower Fox River WLA modeling effort, reported in a January 1980 report, concludes that Lower Fox River dissolved oxygen levels are very insensitive to the rate of nitrification because during the summer months most inorganic nitrogen (ammonia and nitrate) is utilized by algae before it is has a chance to be oxidized. As a consequence, the addition of ammonia at the expected levels would have little impact on the dissolved oxygen profile. The WDNR, therefore, believes that expected effluent ammonia does not limit the feasibility of the proposed dredging plan either by ammonia toxicity or dissolved oxygen depletion.

Although ammonia treatment/removal is not expected, if it were needed, there are technologies including chlorination/dechlorination, a standard wastewater treatment technology (personal communication with Mike Crystal), or pH adjustment which could be added.

Biochemical Oxygen Demand/Dissolved Oxygen: Fox River Assimilative Capacity

Comments were received which concluded there is no assimilative capacity for BOD available for the proposed full-scale remedial dredging project because the Lower Fox River assimilative capacity is already fully allocated to other permitted dischargers. Although it is true that the Lower Fox River's assimilative capacity for BOD is fully allocated, it is commonly understood that, because of the high level of treatment being provided by existing dischargers, much of that allocated load for most of the dischargers is not utilized. To evaluate this issue, the WDNR's Water Quality Modeling Section has calculated the difference between the allocated loadings and the actual discharged loadings. This effort was completed and reported in a June 3, 2002 memorandum, a copy of which is attached.

Over 20 years ago, the Lower Fox River assimilative capacity for BOD was determined by development of a sophisticated WLA model and allocated to the permitted dischargers. This allocation was adopted in NR 112 WAC. Information from NR 112 has been used to develop tables that are placed in the discharger's WPDES permits. These tables established the WLA permit limits for BOD based on various river flows and temperatures. The model divided the River and the associated dischargers into three clusters, which roughly correspond to the four OUs established in the Proposed Plan. Cluster I corresponds to OU 1, Cluster II corresponds to OU 2, and Cluster III includes OUs 3 and 4.

The analysis reviewed wastewater discharge data from 1999 through 2001, and using the worst-case conditions, determined the minimum unused pounds per day of WLA for each discharger in each cluster for that 3-year period. The minimum difference between the permitted allocated load and the actual load for all the dischargers was totaled for each cluster. The results revealed, under the worst-case conditions, that the total difference ranged from 10,688 pounds per day (lbs/d) in Cluster I to 39,531 lbs/d in Cluster III. Under average river flow and temperature conditions, and applying the 1.2 to 1.34 multiplier to the daily maximum WLA permit limit as provided in the WPDES permits, the difference between the permitted loadings and the actual loadings would likely be at least two times the worst-case values shown here.

The BOD discharge expected from implementation of the full-scale dredging project was calculated. Based on the effluent quality obtained in the Lower Fox River demonstration projects, an effluent BOD concentration of 15 mg/L was selected, and effluent flows of 1.4 mgd for OU 1 and 10 mgd for OUs 3 and 4 were selected to calculate the daily BOD discharge anticipated from the project. These values are very conservative in that the flows used were twice the Proposed Plan's estimated flows of 0.7 mgd in OU 1 and 5 mgd in OUs 3 and 4. The assumed effluent BOD of 15 mg/L was just above the highest reported representative value of 13 mg/L in the demonstration projects, which is several times greater than the average effluent BOD concentration in those projects. The resultant conservative BOD discharge estimate from the full-scale dredging project is 175 lbs/d in OU 1, and 1,285 lbs/d in OUs 3 and 4.

Comparing the difference between the permitted loadings and the actual loadings to the estimated dredge process wastewater discharge reveals that the Proposed Plan would only use a maximum of 4.3 percent of the difference. If both OUs 3 and 4 process wastewater is discharged at the same time in Cluster II, as shown below, then the maximum loading is 8.6 percent of the difference. From this analysis, the WDNR has concluded there is substantial available allocated capacity that existing discharges are not using, and the discharge from implementation of the Proposed Plan will not have a significant impact on water quality. Again, this is a worst-case scenario. If typical effluent quality similar to that of the demonstration projects is discharged, the actual BOD discharge will be substantially below these estimates. This exercise also does not account for the fact that the sediment already exerts a significant oxygen demand upon the River, and that removal of the soft sediment results in removal of much of the sediment oxygen demand associated with that sediment.

	Difference Between Permitted Allocations and Actual Discharges (lbs/d BOD)	Percent of Permitted Allocation (%)	Average Percent of Allocation Used (%)	Estimated BOD Discharge from Proposed Plan (lbs/d BOD)
Cluster I	10,688	78.2	21.8	175 (1.6% of unused)
Cluster II	29,536	30.2	30.2	1,285 (4.3% of unused)
Cluster III	39,531	77.5	22.5	1,285 (3.3% of unused)

Based upon the difference between the permitted allocations and the actual discharges for each of the companies responsible for the release of PCBs (see Attachment 2), the estimated wastewater BOD load from the proposed remediation plan is significantly less

than this difference. Given that these companies discharge at levels much less than their current allocated loadings, it is the WDNR's intent to either formally or informally temporarily transfer a portion of that unused capacity from those companies to the proposed Lower Fox River Remediation Project. This was informally done with the Lower Fox River demonstration projects.

Advanced Treatment Technology Ability to Achieve Applicable Water Quality Standards

Comment authors concluded that achieving compliance with expected WQBEL would require wastewater treatment far exceeding Best Demonstrated Available Technology (BDAT) which would require the application of unproven technology with many associated risks. The comment author's report includes a table (Table B-4) comparing the expected performance from BDAT treatment to anticipated WPDES Permit WQBELs which showed compliance with WQBELs was not achievable. This analysis and conclusion are not supported by the effluent PP data from the Lower Fox River Deposit N and SMU 56/57 demonstration projects, which are orders of magnitude lower than that cited for BDAT in the report. Comparison of the assumed BDAT effluent to the demonstration project effluent quality reveals that the BDAT values are not appropriate to use in this case because they do not adequately represent the effluent quality expected from the proposed project. The comment authors also calculated WQBELs, except for NR 106 alternate limits, which when compared to the demonstration project effluent data show that dredge process wastewater can achieve compliance with expected limits for all parameters except PCBs and mercury, as shown in the following table. Although the WQBELs determined by the comment authors were not verified as part of this analysis, the WDNR's evaluation of permit limits reached the same conclusion, except that WQBELs could be determined for PCBs and mercury using the NR 106 alternate limit approach. Since the Proposed Plan effluent quality is expected to be equivalent to the demonstration project effluent quality, it is the WDNR's determination that application of the same or similar treatment technology will achieve compliance with WQBELs. The wastewater treatment technology applied in the demonstration projects was sand filtration and activated carbon absorption, which is not unproven, but is standard technology applied in similar remediation projects around the world.

TABLE 1

Parameter	Demonstration Project Effluent Quality (µg/L unless otherwise indicated)					Panel Report Values Obtained from Tables B-2, B-3, B-4, and B-9 (µg/L)		
	SMU 56/57 1999	SMU 56/57 2000	SMU 56/57 Bench	Deposit N	Deposit N Bench	[3] Best Reported Treatment Results	[4] BDAT (EPA, 1995)	WQBELs Calculated by API Panel
Non BCCs								
Ammonia (mg/L) (before WW improv.)	[2] 1.6–49 (Ave 16.5)	16, 26	34	0.062–29 (Avg 6.0)	6.1			
Ammonia (mg/L) (after WW improv.)	[2] 1.6–17 (Avg 8.0)							
Antimony	< 6.4		< 6.7	< 4.7	8.5			
Arsenic	< 9		< 4.7	< 5.9	5.5	5	20–200	50
Cadmium	< 0.83		< 0.37	< 0.56	2.4	20	200	1.4–3.8
Chloride (mg/L)			32		21			
Chromium^{+6}	< 8.2		< 6.7	< 8.2	< 6.7	10	370 – Total Cr	11 (Cr^{+6})
Chromium (Total)	< 2.0		< 0.64	< 0.6	< 0.64		370 – Total Cr	75–233 (Cr^{+3})
Copper	< 4.7		2	< 1.6	16	20	1,300	6.6–21.6
Lead	< 4.4		< 2.4	< 3	3.3	30	280	14–55
Nickel	< 3.7		< 4.0	7.5	12	100	550	72–271
Selenium	< 8.4		< 4.8	< 9.4	< 0.33		820	5
Silver	< 0.8		< 2.4	< 0.43	< 2.4			
Zinc	< 5.6		14	5	10	200	1,000	66–221
Pentachlorophenol	< 3.7		< 2.4	< 2.5	< 2.4	13	89	5.33–48.7
Fluoranthene	< 0.45		< 0.021	< 0.021	< 0.023			
Endrin	< 0.01		< 0.099	< 0.018	< 0.006	1	2.8	0.072
BCCs								
Dieldrin	< 0.011		< 0.099	< 0.013	< 0.0049	1	17	2.70 E-06
Mercury	< 0.0001–0.1018	< 0.001–0.00045	< 0.0097	< 0.0001	< 0.0097	0.25	150 (Hg^{+2})	0.0013
PCBs	< 0.33 (1 @0.37)	< 0.26	< 0.31	< 0.33 [1](< 0.7–1.6)	< 0.011		13–17	3 E-06
4,4'-DDT	< 0.013		< 0.023	< 0.022	< 0.013			1.1 E-05
2,3,7,8-TCDD (pg/L)	< 7.1		< 2.7	< 4.8	< 0.8		0.063 µg/L	3 E-09

Notes:
[1] These values are from the first 2 weeks of the project.
[2] The 1999 SMU 56/57 data provided in the top cell is for the overall project performance and the data in the next cell below is only for that period after wastewater modifications were completed 6 weeks into the project, which is considered more representative of a properly operating treatment facility.
[3] Best Reported Treatment Results values obtained from 1985 text, *Industrial Wastewater Treatment Technology*, by J. W. Patterson.
[4] BDAT – Best Demonstrated Available Technology (EPA, 1995) as presented in the Panel Report dated December 20, 2001.

Limitation of Proposed Process Wastewater Discharge Rate Based on Assumed Effluent Cadmium, Dieldrin, Endrin, and Mercury Concentrations

Comment authors concluded the assimilative capacity of the Lower Fox River would limit the discharge rate of sediment remediation process wastewater to 4.25 mgd, based on assumed effluent concentrations of dieldrin, endrin, mercury, and cadmium. This conclusion is apparently based on assumed effluent contaminant concentrations, which were described as "Best Reported Treatment Results" and obtained from a 1985 text authored by J. W. Patterson (one of the comment authors). Using these assumed concentrations, the maximum wastewater discharge rate, which would not exceed the assimilative capacity of the River was calculated to be 8.4 mgd for cadmium, 1.25 mgd for mercury, and 3.12 mgd for endrin, producing an average of 4.25 mgd. Dieldrin had a much lower assimilative capacity based discharge rate of 0.04 mgd, but was discounted.

As in the previous discussion, these conclusions are not based on representative data. They did not consider the Lower Fox River demonstration project effluent data, which the WDNR believes is the most appropriate data to use in estimating future effluent quality from the proposed Lower Fox River remediation project.

Review of the four demonstration project PP data sets reveal that dieldrin and endrin were not detectable at LODs of 10 to 100 times lower than the Panel Report-assumed values. Since dieldrin and endrin were not detected in any effluent samples, permit limits would not be given for these parameters using normal limit setting procedures; therefore, the discharge rate would not be influenced or limited by these parameters.

Three of four samples did not detect cadmium at an LOD of 20 to 50 times lower than the assumed value, and one sample detected cadmium at an about one-tenth of the assumed value. These values are well below anticipated permit limits.

Mercury was the only parameter analyzed in three of the four PP data sets; however, it was also analyzed weekly during the demonstration projects. Mercury was not detected in any of the three PP analyses, with LODs of 10 to 1,000 times lower than the assumed value. During the SMU 56/57 year 2000 demonstration project, about 19 mercury samples were collected of which 14 had no detects at an LOD 2,000 times lower than the assumed value, and 5 values had detected concentrations, the highest of which was 500 times lower than the assumed value. The Deposit N and SMU 56/57 (year 1998) project effluent mercury values were mostly detectable at levels similar to those detected in SMU 56/57 (year 2000). Influent wastewater mercury analysis was also done on samples collected just prior to the wastewater treatment process. These mercury concentrations of untreated wastewater were also far below the assumed values used in the Panel Report for treated effluent. Mercury has, however, already been identified as having no available assimilative capacity because Lower Fox River background concentrations already exceed the mercury water quality standard, and is eligible for alternate permit limits.

Replacing the Best Reported Treatment Results assumed in the Panel Report with the actual Lower Fox River demonstration project effluent data, but keeping all the other assumptions the same, increases the assimilative capacity based wastewater discharge rate by a factor of at least 20, from 4.25 mgd to at least 80 mgd. Based on this analysis, the WDNR has concluded that the assimilative capacity of the Lower Fox River will not limit the discharge rate due to cadmium, dieldrin, endrin, mercury, or any other parameter.

Wastewater Generation Rate Impacts on Dredge Rate and Dredge Schedule

The prior discussions address the comments that claim that the expected quality of the dredge process wastewater generated from implementation of the Proposed Plan would result in limitation of the discharge rate to 4.25 mgd. Additional comments took this maximum discharge rate of 4.25 mgd and projected its impact on the length of time it would take to complete dredging the 7.3 million cy of sediment recommended in the Proposed Plan. Although this subsequent projection of discharge volumes is not directly related to effluent quality and associated probable permit limits, it was used as the basis

for concluding that dredging is not viable due to discharge volume, so it will be briefly discussed here.

The comment authors claim the wastewater generation rate from dredging would be about 4,100 gal/cy of dredged sediment, which is about five times the value used in the Proposed Plan. Using this 4,100 gal/cy value increases the volume of dredge process wastewater from the Proposed Plan estimates of 0.7 mgd in OU 1 and 5.0 mgd in OUs 3 and 4, to 4.3 mgd in OU 1 and 23.7 in OUs 3 and 4. The comments next assumed that based on a maximum allowable discharge rate of 4.25 mgd and a wastewater generation rate of 4,100 gal/cy of dredged sediment, the maximum allowable dredge rate would be about 1,050 cy/d, which would increase the Proposed Plan's estimated 7-year dredge schedule to as much as 37 to 60 years. These issues were addressed in detail in the Responsiveness Summary. The WDNR essentially concluded that an estimated wastewater generation rate of 4,100 gal/cy of dredged sediment is not reasonable, the dredge rate would not be limited to 1,050 cy/d and the Proposed Plan's estimated dredge rate of 5,770 cy/d is a reasonable expectation for the full-scale dredging process. The Proposed Plan's estimated 7-year dredge schedule is, therefore, still considered to be a reliable estimate. The determination was also made that even if wastewater generation rates were as high as the comments claimed, there would not be any limitation to the wastewater discharge rate and associated dredge rate or dredge schedule.

CONCLUSIONS

This paper was written to address comments that claimed that the dredging recommended in the Proposed Plan for the Lower Fox River and Green Bay was not viable. This conclusion was based on the assumption that the quality and quantity of wastewater generated in the dredging process could not comply with WQS and associated WPDES permit limits, and that the quality and quantity of dredge process wastewater would restrict the allowable wastewater discharge rate, thereby decreasing the allowable dredging rate and increasing the dredge schedule from the 7 years estimated in the Proposed Plan to as much as 37 to 60 years.

This evaluation concludes that the expected quality and quantity of the dredge process effluent will comply with Water Quality Based Effluent Limits, and will not restrict the effluent discharge rate or associated dredge schedule. The expected effluent quality and quantity do not, therefore, limit the viability of the proposed remedial dredging project, and does not justify in-place sediment capping. Additional significant specific conclusions are as follows:

1) The dredge process effluent quality assumed by the comment authors is not representative of expected Lower Fox River dredge process effluent quality.

2) The wastewater quality achieved from the Lower Fox River Deposit N and SMU 56/57 demonstration projects provides the best representation of the effluent quality expected from the full-scale dredging of the Lower Fox River, and will be used for estimating expected effluent quality.

3) Effluent quality would not limit the ability of the project to comply with expected wastewater WPDES permit limits.

4) Effluent quality would not restrict the expected effluent discharge rate based on the Lower Fox River assimilative capacity for cadmium, dieldrin, endrin, mercury, or any other parameter.

5) WQBELs for toxic and organoleptic compounds regulated under WAC NR 106 are only needed for PCBs and mercury.

6) PCB and mercury WQBELs will be determined using the Alternate Limit procedures provided in NR 106.06(6) WAC, because background Lower Fox River concentrations of PCBs and mercury exceed WQS.

7) The Lower Fox River assimilative capacity for BOD is fully allocated, however, much of that capacity is unused by the permitted dischargers. Much of that unused capacity is held by the paper companies who are the potentially responsible parties for the PCB contamination of the River, and could be available for temporary use by this remediation project. Effluent from full-scale implementation of the proposed dredging plan would only use a small percentage (less than 10 percent) of the unused or available assimilative capacity of the River.

8) Effluent quantity estimates contained in the comments are not reasonable, do not limit the allowable dredge rate, and would not extend the dredge schedule beyond the 7 years estimated in the Proposed Plan.

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ATTACHMENT 1
DISCHARGE LIMITATIONS FOR THE PROPOSED DISCHARGES FOR THE LOWER FOX RIVER PCB REMEDIATION PROJECTS

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: August 21, 2002

TO: Bruce Baker – AD/5

FROM: Al Shea – WT/2

SUBJECT: Discharge Limitations for the Proposed Discharges for the Fox River PCB Remediation Projects (Operable Units 1, 3, and 4)

This document describes the methodology the Department will use in the development of effluent limitations for the discharges from the proposed remediation projects to the Lower Fox River. It contains a discussion for applying the provisions of existing state water quality standards (including the calculation of water quality-based effluent limitations (WQBELs)) and the WPDES program in permits for the proposed discharges.

The substances discussed here are chosen because we feel these compounds are of the greatest concern, although limits for other substances may be calculated in the future as needed. Based on the projects themselves, compounds found in the water column and/or sediments, bioaccumulation potential, and assimilative capacity issues, the primary concerns at this time are related to PCBs, mercury, and ammonia.

WQBELs FOR PCB AND MERCURY

PCBs and mercury are among the list of bioaccumulating chemicals of concern (BCCs) identified in current DNR rules (ss. NR 105.03(9), 106.06(2), and NR 207.02(6)(c), Wis. Adm. Code). New discharges of BCCs to the Great Lakes basin at this time, and all discharges to the Great Lakes basin after March 23, 2007, must meet effluent limits that are equal to the lowest water quality criterion available in ch. NR 105, Wis. Adm. Code. These criteria are much less than the current level of detection for these substances. For both PCBs and mercury, sampling data demonstrates that background concentrations in the Fox River are greater than the lowest criterion for each substance. Therefore, alternative effluent limitations may be considered for PCBs and mercury under ss. NR 106.06(6)(c) and (d), Wis. Adm. Code. Specifically, under the provisions of s. NR 106.06(6)(c), Wis. Adm. Code, whenever background is greater than the criteria and the source of wastewater is from the same body of water, effluent limitations may be set equal to the background concentrations of these substances or an alternative limitation or requirement may be established using the procedure in s. NR 106.06(6)(d), Wis. Adm. Code.

Section NR 106.06(6)(d), Wis. Adm. Code, authorizes the establishment of alternative limitations when (1) the discharger's relative contribution to the mass of the substance impacting the waterbody or stream segment is considered to be negligible in the best professional judgment of the Department and (2) the concentration of the substance in the discharge exceeds the representative background concentration. Under these circumstances, alternative limitations may be established based upon the Department's application of "the best demonstrated treatment technology reasonably achievable." The alternative effluent limitation may include one or more of the following:

1. A numerical limitation for the substance,
2. A monitoring requirement for the substance, or
3. A cost-effective pollutant minimization program for the substance as defined in s. NR 106.04(3).

The water discharged as a result of these projects will contain a small fraction of the contaminants that are already in place in the sediments of the Fox River. The removal of the sediments will significantly reduce the mass amount of PCB and mercury that may move from the sediment to the water over time. It will also reduce the amount of these substances that may enter Lake Michigan in the future. There will be no new introduction of contaminants to the system, but there will be a significant net removal from the system.

The projects being planned will remove approximately 29,250 kilograms of PCB that is currently in the system. It is estimated that the PCB discharged in the carriage return water from the dredging projects will be less than about 10

kilograms with the application of "best demonstrated treatment technology reasonably achievable" as described below. Because mercury will be similarly removed in the treatment processes employed, it is estimated there will be a similar significant net removal of mercury from the system. Thus, this discharge, in comparison to the overall net removal of substances from the river, represents a negligible contribution, in our judgment. Therefore, it is appropriate to use the provisions of NR 106.06(6)(d), Wis. Adm. Code, to establish effluent limitations for these projects.

LIMITATIONS FOR BEST DEMONSTRATED TREATMENT TECHNOLOGY

In conformance with the above-noted provision of NR 106.06, Wis. Adm. Code, the Department may establish effluent limitations for total PCBs and total recoverable mercury that represent the application of BDTTRA. This section of the memo will specify permit requirements for carriage return water that is generated during the remediation dredging projects on the Lower Fox River. These requirements represent the application of "best-demonstrated treatment technology reasonably achievable" (BDTTRA).

We have reviewed available information on the treatment technology that was used as part of the Fox River Deposit N, Deposit O and Sediment Management Unit (SMU) 56/57 remediation projects. That technology, or very similar technology, represents, in our judgment, "best-demonstrated treatment technology reasonably achievable" (BDTTRA). The sediments that are hydraulically removed from the river are processed through a system consisting of coagulant-assisted gravity settling and pH adjustment, with settled sediment dewatered using a plate and frame filter press. The settling basin supernatant and the press filtrate are treated by sand-filtration and are passed through granular activated carbon. PCB and mercury effluent quality from these projects and with this technology is superior to any presented by EPA in its *Manual Ground-Water and Leachate Treatment Systems* (EPA/625/R-94/005, January 1995) and *Treatability Manual* (EPA-600/2-82-001a, Reprinted February 1983). At the time permits are issued for these projects, there will be an additional evaluation of BDTTRA to determine if additional treatment technology is appropriate.

This BDTTRA technology is capable of attaining, as demonstrated in the aforementioned projects, an effluent total PCB concentration on a daily maximum basis of less than the limit of detection when using EPA Method SW-846 8082. Method SW-846 8082 should provide a limit of detection of 0.1 to 0.5 µg/L and, we believe this is the level of performance that can be achieved with the technology described above. Specifically, this is supported by effluent data from the SMU 56/57 project after October 16, 1999, when separate treatment of settling basin supernatant and press filtrate began.

As with PCB and, as demonstrated in the aforementioned projects, the dewatering and treatment technology described above is determined to be BDTTRA and is capable of attaining a performance level that produces effluent mercury concentrations of less than the limit of detection when using EPA Method 1631. Method 1631 should provide a limit of detection of about 0.2 ng/L and a minimum level (ML), which is roughly equivalent to the limit of quantitation, of 0.5 ng/L. This limitation is supported by effluent data from the second year of the SMU 56/57 project. The second year of the project is selected because operation of the treatment system was improved during the second year.

AMMONIA LIMITATIONS

Based upon the characterization of sediment quality (ammonia is a constituent in the sediment) and water discharged from sediment treatment facilities, effluent limitations for ammonia have also been evaluated. Because ammonia limitations depend on temperature and pH characteristics of the receiving water, we have evaluated the need for effluent limitations using background data recently used to calculate limits for municipalities along the Lower Fox River(e.g., Neenah – Menasha, Heart of the Valley and Appleton). This evaluation has also employed the Department's most reasonable estimate of flow volumes from the dredging project units. Under these circumstances, effluent ammonia limitations are substantially greater than projected effluent quality and ammonia limits will not be needed.

cc: Gary Kincaid – NER
Ed Lynch – RR/3

ATTACHMENT 2
UNUSED FOX RIVER ASSIMILATIVE CAPACITY FOR BOD

CORRESPONDENCE/MEMORANDUM

State of Wisconsin

DATE: June 3, 2002 FILE REF: 8250

TO: Gary Kincaid - NER

FROM: Jeff Kreider - WT/2

SUBJECT: Unused Lower Fox River Assimilative Capacity in Clusters I, II and III

The intention of this memo is to update the memo I wrote on May 2, 2002 to Gary Kincaid. This memo fixes an error in Table 1, where the Fort James East and Fort James West values were switched. This memo also includes the Cluster II table and incorporates the possibility of having the remediation discharge for the sediment dredged from Cluster III located in Cluster II.

The plan for the remediation of the PCB contaminated sediments in the Lower Fox River/Green Bay site, published in the October, 2001 proposes a combination of the remediation dredging and monitored and natural recovery to reduce the risks associated wit the site. According to the plan, hydraulic dredging would be conducted to remove the sediment and ultimately, the sediment would be dispose of at an upland disposal site. This process would result in a return flow of water after the transport and dewatering of the sediment.. Comments were received on the proposed plan questioning the feasibility of the proposed plan.

In a DRAFT memo to Ed Lynch from Jeff Haack, the Water Quality Modeling section was asked to look into the available assimilative capacity for the proposed remediation discharge in Clusters I and III.

Four dischargers were evaluated for potential load reductions to allow for the remediation discharge, in Cluster I, P.H. Glatfelter and American Tissue; in Cluster II, Appleton Paper; and in Cluster III, Fort James West. The analysis uses spreadsheets generated from the SWAMP system for years 1999-2001; information from 1999 and 2000 discharge data for the SMU 56/57 remediation; the individual NR 212 tables for the above mentioned dischargers; and only considers BOD_5. The spreadsheets from the Department's System for Wastewater Applications, Monitoring, and Permits (SWAMP) system contained all the data from the DMRs and needed to be reformatted to make them easier to use. Two columns were added and calculations completed: 'Unused WLA lbs/day' and 'WLA Percent Used'. The spreadsheets were sorted on the 'WLA Value' column showing the minimum WLA value used during the three year time period. The 'WLA Percent Used' column was evaluated to determine the maximum percentage used at the lower WLA values.

The analysis assumes a 1 : 3 BOD_5 : BOD_{ult} ratio for the remediation discharge using the following equation.

$$(FL * FR * PU - RL * RR) / FR = RA$$

Where FL: facility load (lbs/day)
FR: facility BOD_5 : BOD_{ult} ratio
PU: Percent of unused allocation
RL: remediation discharge load (lbs/day)
RR: remediation discharge BOD_5 : BOD_{ult} ratio
RA: remaining unused wasteload allocation

The analysis uses the smallest number indicated in the NR 212 tables (low flow, high temperature) which is the worst case scenario condition for each discharger listed above. Then the minimum percentage of the discharger's unused wasteload allocation is multiplied by the NR 212 number giving the unused portion of the discharger's wasteload allocation.

Cluster I

The maximum projected flow (two times the projected flow) for the remediation discharge is 1.39392 MGD. The maximum concentration in the SMU 56/57 discharge was 13 mg/l after the treatment system was redesigned in the first

year after October 16, 1999. This number was rounded up to 15 mg/l to remain on the conservative side for this analysis. The maximum projected BOD_5 load is then 175 lbs/day.

Based on the information provided in the SWAMP generated spreadsheets, P.H. Glatfelter used no more than 23% of their wasteload allocation and American Tissue used no more than 43% of their wasteload allocation. Using the NR212 tables, at worst case scenario (low flow, high temperature) conditions, P.H. Glatfelter is allocated 4017 lbs/day and Wisconsin Tissue is allocated 1462 lbs/day. The intent of scenarios 1 and 2 is to show each facility's remaining wasteload allocation after all or some portion of the remedial discharge's wasteload allocation has been removed.

Scenario 1 – Take All Projected Remediation Discharge from A Single Discharger

Scenario 1A

P.H. Glatfelter - The remaining unused allocation is 2812 lbs/day (Eq. 1).

$$(4017 * 1.87 * (100\% - 23\%) - 175 * 3) / 1.87 = 2812 \text{ lbs/day} \quad \text{Eq. 1}$$

Scenario 1B

American Tissue - The remaining unused allocation is 738 lbs/day (Eq. 2).

$$(1462 * 5.5 * (100\% - 43\%) - 175 * 3) / 5.5 = 738 \text{ lbs/day} \quad \text{Eq. 2}$$

Scenario 2 – Use Weighted Distribution of Remediation Discharge

Considering only P.H. Glatfelter's and American Tissue's discharge, P.H. Glatfelter has 73.3% of the total discharge and American Tissue has the remaining 26.7%. P.H. Glatfelter's remaining unused allocation is 2887 lbs/day (Eq. 3) and Wisconsin Tissue's remaining unused allocation is 808 lbs/day (Eq. 4).

$$(4017 * 1.87 * (100\% - 23\%) – 175 * 3 * 73.3\%) / 1.87 = 2887 \text{ lbs/day} \quad \text{Eq. 3}$$

$$(1462 * 5.5 * (100\% - 43\%) – 175 * 3 * 26.7\%) / 5.5 = 808 \text{ lbs/day} \quad \text{Eq. 4}$$

Cluster II or III

The maximum projected flow (two times the projected flow) for the remediation discharge is 10.26144 MGD. The maximum concentration in the SMU 56/57 discharge was 13 mg/l after the treatment system was redesigned in the first year after October 16, 1999. This number was rounded up to 15 mg/l to remain on the conservative side for this analysis. The maximum projected BOD_5 load is then 1285 lbs/day. The intent of scenarios 1 and 2 is to show each facility's remaining wasteload allocation after all or some portion of the remedial discharge's wasteload allocation has been removed.

Scenario 1 – Remediation Site Located In Cluster II

Based on the information provided in the SWAMP generated spreadsheets, Appleton Paper used no more than 56.2% of their wasteload allocation. At worst case scenario conditions, Appleton Paper is allocated 3509 lbs/day. Under these conditions Appleton Paper's remaining unused allocation is 810 lbs/day (Eq. 5).

$$(3509 * 5.3 * (100\% - 56.2\%) – 1285 * 3) / 5.3 = 810 \text{ lbs/day} \quad \text{Eq. 5}$$

Scenario 2 – Remediation Site Located In Cluster III

Based on the information provided in the SWAMP generated spreadsheets, Fort James West used no more than 8.5% of their wasteload allocation. At worst case scenario conditions, Fort James West is allocated 8979 lbs/day. Under these conditions Fort James West's remaining unused allocation is 7445 lbs/day (Eq. 6).

$$(8979 * 5 * (100\% - 8.5\%) – 1285 * 3) / 5 = 7445 \text{ lbs/day} \quad \text{Eq. 6}$$

Additional Information

Table 1 shows the amount of unused wasteload allocation at the observed lowest flow, highest temperature condition for the Lower Fox River. The reason for using this condition is that the river flow and temperature does not change significantly within the cluster, therefore all percentages are near the same time period. As the table indicates, Cluster I had 10,688 lbs/day of available allocation, Cluster II had 29,536 lbs/day of available allocation and Cluster III had 39,531 lbs/day of available allocation. As flow increases and/or temperature decreases the available allocation will generally increase for the clusters.

To better understand the impact on the water quality by the remediation discharges in Cluster I and III for BOD_5, the amount of dissolved oxygen depleted from the water column was calculated. Based on the low flow of 750 cfs found in the NR 212 tables for the Lower Fox River, a BOD_5 load of 4045 lbs/day would deplete the dissolved oxygen 1 mg/l. Therefore, the dissolved oxygen depletion due to the remediation discharge in Clusters I (175 lbs/day / 4045 lbs/day) and II or III (1285 lbs/day / 4045 lbs/day) are 0.043 mg/l and 0.32 mg/l respectively. Generally the accuracy of a dissolved oxygen meter is 0.2 mg/l.

If the decision is made to take some of a facility's allocation away and give it to the remediation discharge, a BOD_5 to BOD_{ult} ratio should be determined for the remediation discharge.

Conclusion

The analysis shows substantial available wasteload allocation capacity for the remediation discharge to borrow from the Cluster I and, II or III facilities named above and should not adversely effect the facilities' production schedule, based on their past three years of production. It is also safe to assume that all of the dischargers in Clusters I, II and III will not be discharging more than 22%, 23%, and 31% respectively of their wasteload allocation on average based on the last three years of production. This leaves a considerable amount of assimilative capacity for the remedial discharge's use. The amount of dissolved oxygen depleted from the water column by the remediation discharge is less than 0.32 mg/l and becomes much less as the river flow increases. Therefore , the amount of BOD_5 discharge from the remediation sites will not have a significant impact on water quality.

A discussion needs to take place as to where the best outfall location for the remediation discharge. This analysis does not indicate approval or disapproval for any location so long as the outfall location is in the same cluster as a facility being reduced, if a facility will have its wasteload allocation reduced. Due to the low percentages of wasteload allocation used by the facilities the actual outfall location within a cluster won't effect the water quality.

Table 1: Available Assimilative Capacity At Worst Case Scenario Conditions for Clusters I and III

Cluster I **Facility**	**Unused lbs/day**	**Percent Used**
American Tissue	1095	42.8%
Kimberly Clark	682	34.9%
Neenah-Menasha POTW	2782	9.2%
Grand Chute-Menasha West	1336	8.7%
P.H. Glatfelter	3675	10.3%
SCA Tissue	1118	25.0%
Total Unused WLA	**10,688**	
Average Percent Used		**21.8%**

Cluster III **Facility**	**Unused lbs/day**	**Percent Used**
International Papers	1071	30.2%
De Pere POTW	2824	16.5%
Fort James West	12,506	1.4%
Fort James East	527	85.7%
Proctor & Gamble	10,726	4.6%
Green Bay Packaging	1882	14.4%
Green Bay POTW	9995	4.9%
Total Unused WLA	**39,531**	
Average Percent Used		**22.5%**

Cluster II **Facility**	**Unused lbs/day**	**Percent Used**
Kerwin	1071	69.5%
Appleton POTW	2824	13.2%
Stora Enso North America	12,506	11.9%
Appleton Paper	527	56.2%
Heart of the Valley POTW	10,726	1.9%
International Papers	1882	28.4%
Total Unused WLA	**29,536**	
Average Percent Used		**30.2%**

Table 2: Example of Re-Allocation of Wasteload Allocation

Facility	**BOD_5 lbs/day**	**BOD_5 to BOD_{ult}**	**BOD_{ult} lbs/day**
P.H. Glatfelter	4017	1 : 1.87	7522
American Tissue	1462	1 : 5.5	8041
Kerwin	1000	1 : 3	3000
Fort James West	8979	1 : 5	44895
Remediation Discharge	1285	1 : 3*	3855

* Ratio is an approximation only.

Cc: Greg Hill - WT2
Ed Lynch - RR/3
Jeff Haack - NER